

NORTH DAKOTA STATE UNIVERSITY

Aerial Camera for Nest Observation

User Manual

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Table of Contents

Introduction	2
Equipment.....	2
Product Use:.....	2
Readying the Enclosure.....	2
User Program	9
Camera	9
Camera Compatibility	9
Downloading CHDK	9
Installing CHDK.....	10
PC User Software	12
Installing the Software	12
How to Use.....	12
Figure 1: Empty Enclosure	2
Figure 2: Opening Cover	3
Figure 3: Inserting Camera.....	3
Figure 4: Inserting Camera.....	4
Figure 5: Wrong Placement of Strap.....	4
Figure 6: Inserting USB.....	5
Figure 7: Unconnected Power Regulator	5
Figure 8: Connecting Ardunio	6
Figure 9: Connecting the Battery	7
Figure 10: Connected Right.....	7
Figure 11: Where to Insert Zip Tie	8
Figure 12: Zip Tied Enclosure	8
Figure 13: Screenshot for choosing camera	9
Figure 14: CHDK Setup	10
Figure 15: CHDK Setup continued.....	11
Figure 16: Camera loading screenshot	12
Figure 17: Photo Form	13
Figure 18: Choose USB Port	14
Figure 19: XBee inserted in to USB Port	14

Introduction

This device is used to obtain accurate census/nest information for the Franklin's Gull.

Equipment

- Weather Balloon
- Transmitting board
 - Xbee (Wifi Antenna)
 - Break-out Board
 - Arduino Board
 - USB adapter
- Canon PowerShot SD870 IS
- Plexiglass
- USB cables
- Fishing Line
- Balloon Tether
- Voltage Regulator
- Battery
- PCB Board
- Helium

Product Use:

Readying the Enclosure

The plexiglass enclosure is the housing for the camera and the other equipment that will be deployed into the air with the balloon.

The enclosure without a camera will look like the picture below, with two Velcro straps and a USB cord unattached.

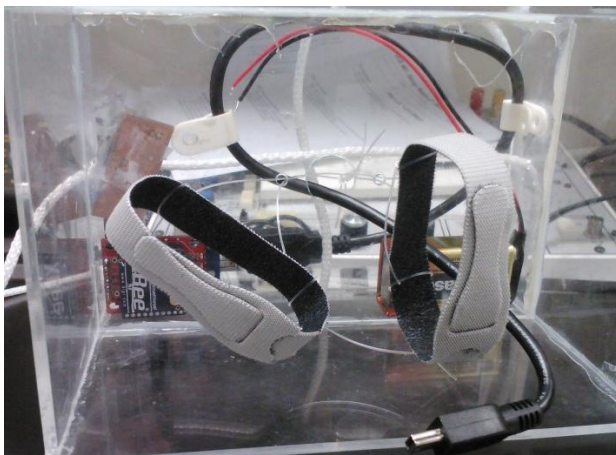


Figure 1: Empty Enclosure

The next step is to open the cover to the USB port (if needed depending on model of camera).



Figure 2: Opening Cover

Insert the camera with the enclosure lying on its side. Be sure to have the camera screen facing the inside of the enclosure.

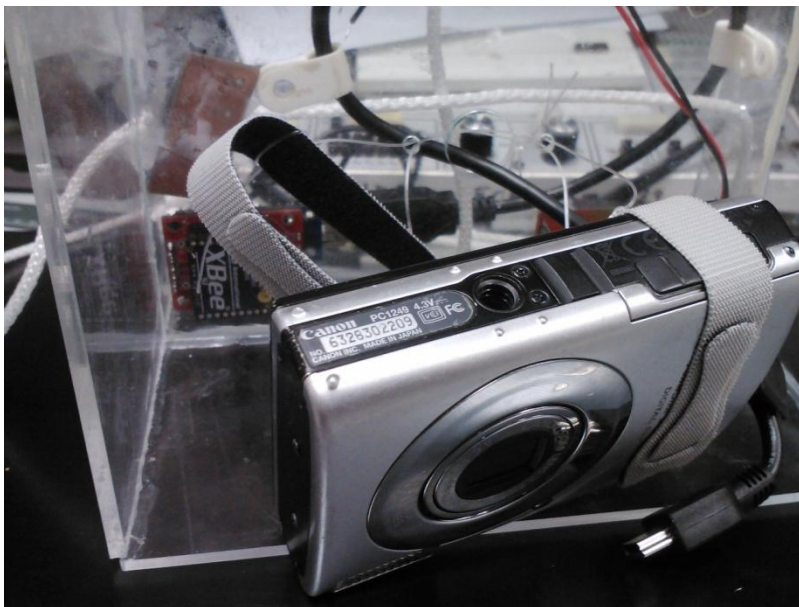


Figure 3: Inserting Camera

Place second strap over other side of the camera.

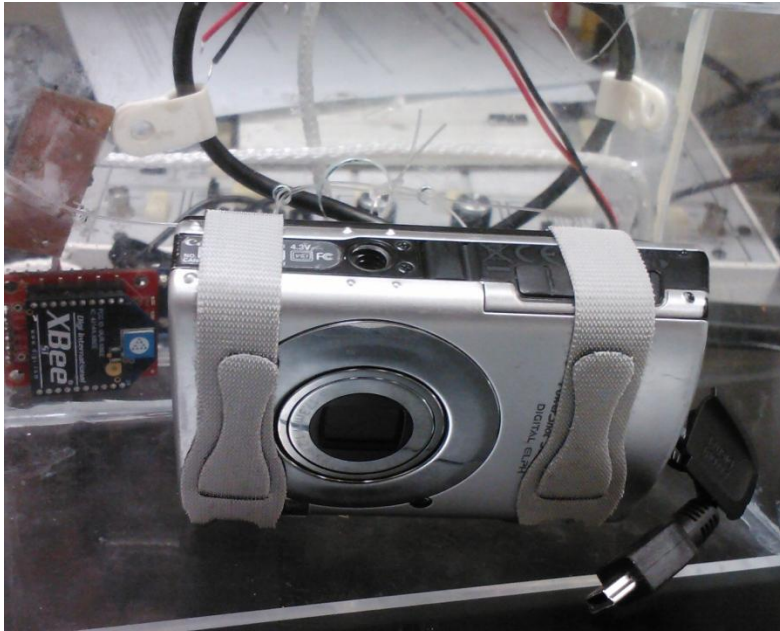


Figure 4: Inserting Camera

When placing the strap nearest the lens, make sure it placed far enough onto the camera but not to cover the lens like in the picture below.



Figure 5: Wrong Placement of Strap

Now that camera is placed into the straps correctly connect the USB cord to the USB port in the camera.



Figure 6: Inserting USB

Once the camera is fully connected place the box with the camera facing downwards. Inside of the top enclosure is a power regulator board that must be connected for full functionality. This board is pictured below.

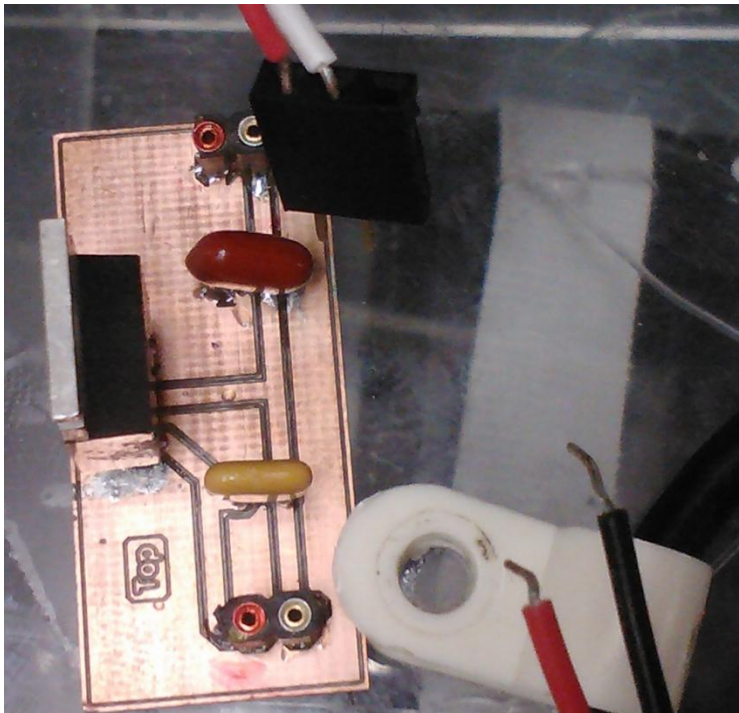


Figure 7: Unconnected Power Regulator

Now that the board has been located, place the red and white wires that have been inserted in a set of black headers into the set of headers closest to the red capacitor. The red side will be inserted into the header that has been colored red or if the ink is no longer visible the side closest to the black power regulator.

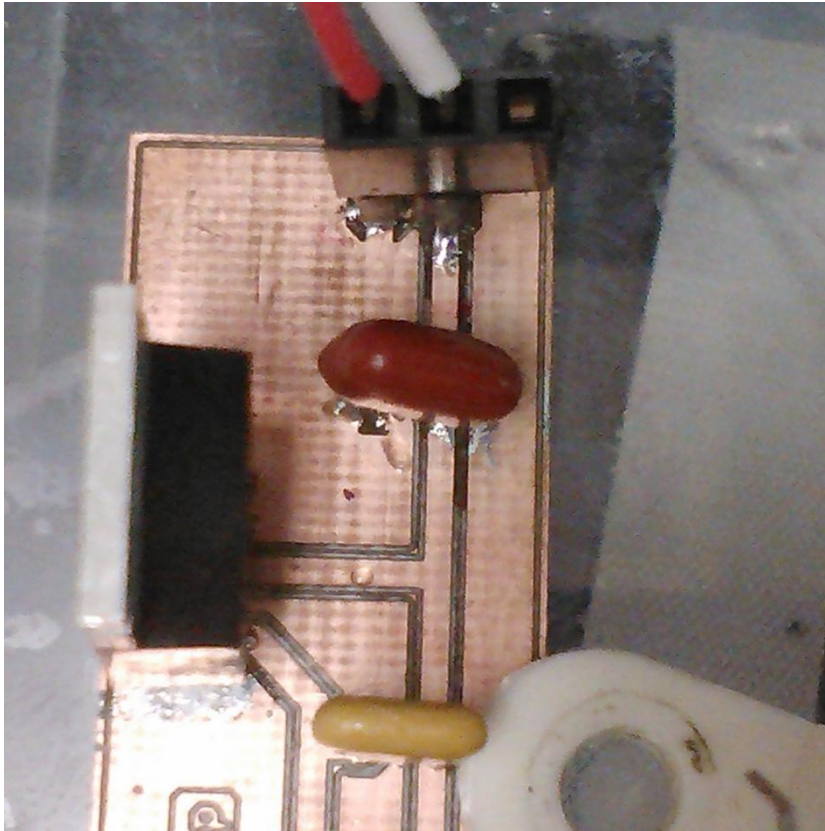


Figure 8: Connecting Arduino

There are also two wires that connect the battery to this board. These go in the headers closest to the yellow capacitor. The red wire goes into the header that has been colored red or closest to the black power regulator if the red ink is no longer visible. The black wire is inserted into the same set of headers next to the red one.

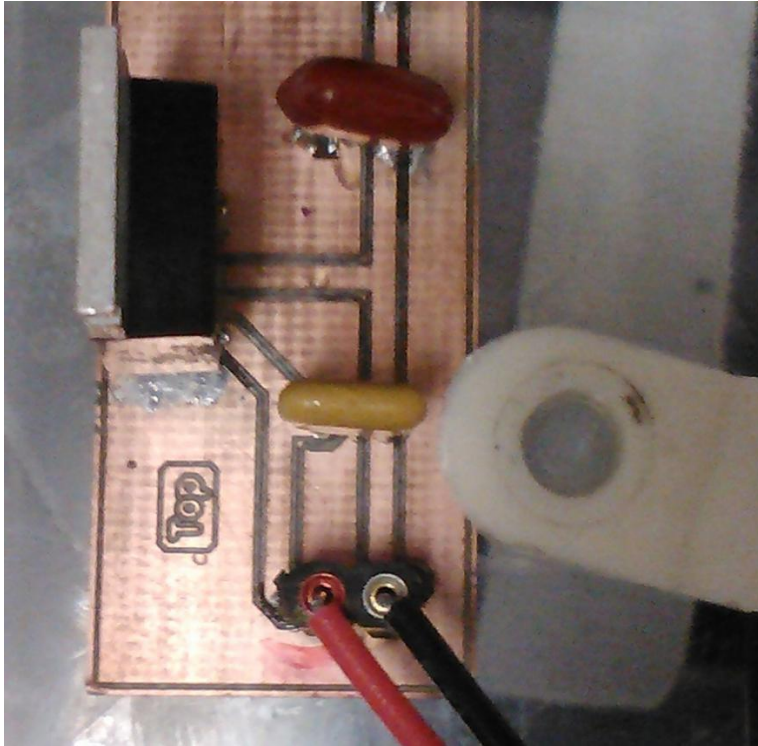


Figure 9: Connecting the Battery

Once the Arduino and the battery have been connected, this red light should turn on. If this does not turn on make sure the connections are secure or replace the 9V battery.

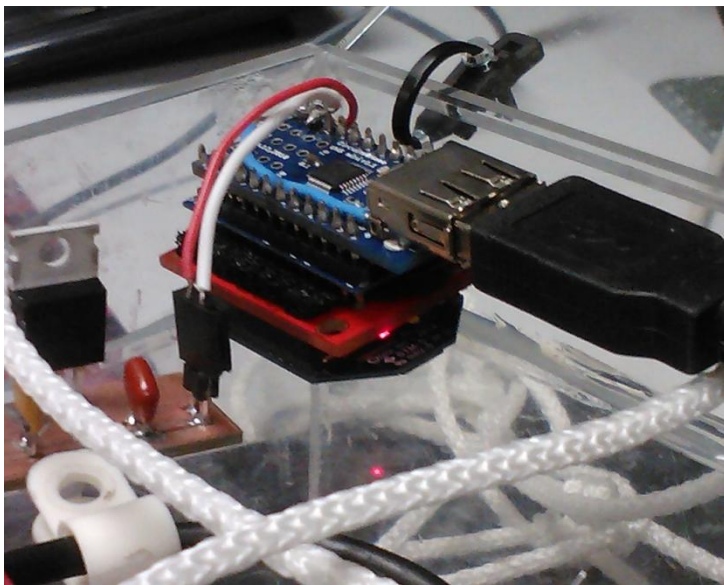


Figure 10: Connected Right

Once you are ready to deploy the enclosure it must be secured shut. The two holes are shown in the picture below.

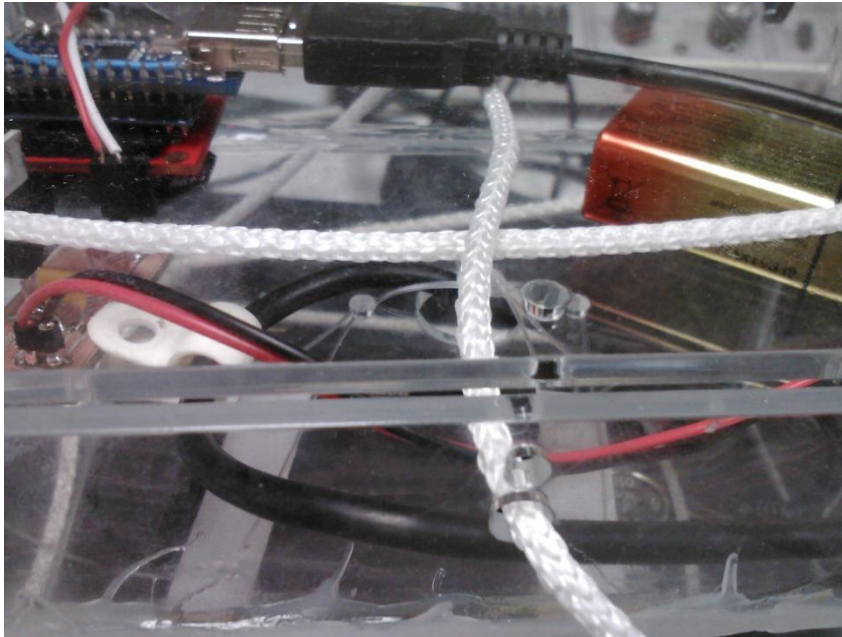


Figure 11: Where to Insert Zip Tie

Insert a zip tie and secure shut.

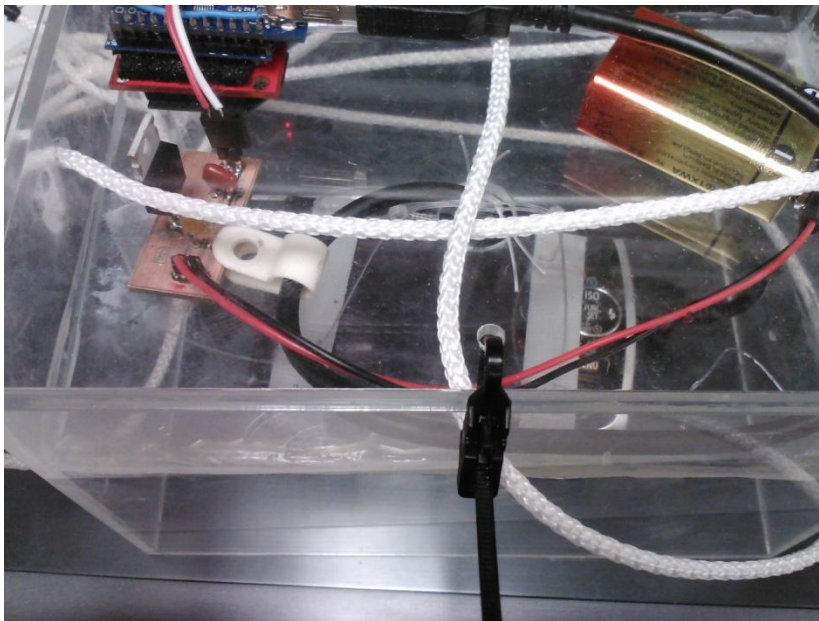


Figure 12: Zip Tied Enclosure

NOTE: When done using the product please disconnect the battery and the Ardunio from the power regulator to prevent loss from the battery.

User Program

- To ready plexiglass enclosure
- Inflate balloon with 87 cubic feet of helium

Camera

The camera must be prepared before it will be able to interface with the rest of the product. The Canon Hack Development Kit (CHDK) is used to provide functionality that most cameras do not include out of the box. CHDK is a third party firmware. It is installed to the camera's memory card and runs on top of the stock firmware, leaving the software on the actual camera untouched. This section will include a step-by-step tutorial for installing CHDK on a camera. Full documentation of CHDK is available at <http://chdk.wikia.com/wiki/CHDK>. The instructions below assume you are using a computer running Windows and that you have an SD card for use with your camera and an SD card reader. If your SD card is larger than 2 GB, it must be divided into two separate partitions. One of these partitions must be smaller than 2 GB in size and it should be formatted with the FAT file system.

Camera Compatibility

CHDK is compatible with many Canon PowerShot series cameras, including most A-series, S-series, and SD series cameras. CHDK must be developed for each camera model by volunteers and hobbyists, so brand new PowerShot models are not usually supported immediately. The full list of compatible cameras is located on CHDK's wiki page.

Downloading CHDK

Before downloading CHDK, you first need to determine your camera's model and firmware version. You may need to download different software based on these two parameters. The camera's model should be printed somewhere on the camera body. Finding the firmware version requires a few more steps. The easiest way to find the camera's firmware is by using a tool to examine a photo taken by the camera. The photo's metadata contains information about the camera, including model and firmware version information. An application for examining this information was written by CHDK users. This application can be downloaded from <http://savedonthe.net/download/247/CameraVersion13-sfx.html>. To use the application, open it and click the Browse button. Then, use the file browser to select an image that was taken with the camera you wish to know about. The program then displays the firmware version. An example is shown here:

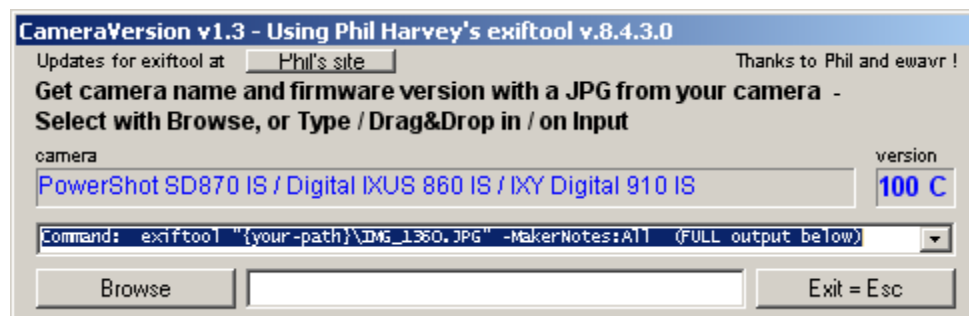


Figure 13: Screenshot for choosing camera

The camera is a PowerShot SD870 and its firmware version is 100C. You may also want to note alternate names for your camera's model. Some cameras were sold as different models in overseas markets and some websites may refer to these model names instead of the one printed on your camera.

Once the firmware version is known, you can then download the proper firmware version from the Internet. The website <http://mighty-hoernsche.de/> contains all of the different versions of CHDK for each camera and firmware version. Browse to the camera model you have and select the file that corresponds to your firmware version.

Installing CHDK

The easiest way to install CHDK is to use an application called CardTricks. This application can be downloaded from <http://savedonthe.net/download/247/CameraVersion13-sfx.html>. Put your SD card into your card reader and plug the reader into the computer. Then, start CardTricks. Click on the picture of the SD card to select your SD card. If your SD card is partitioned, select the smaller of the two partitions.

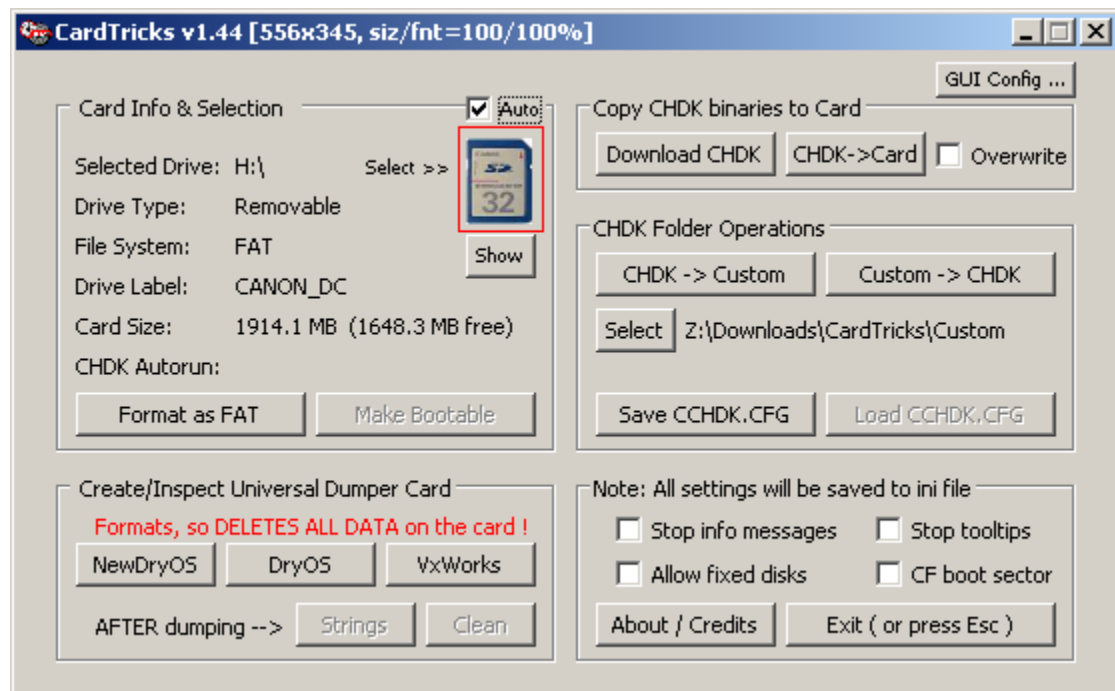


Figure 14: CHDK Setup

Once your SD card has been selected, click on the Make Bootable button. This will make it so that CHDK runs every time the camera powers on.

Next, click on the CHDK->Card button:

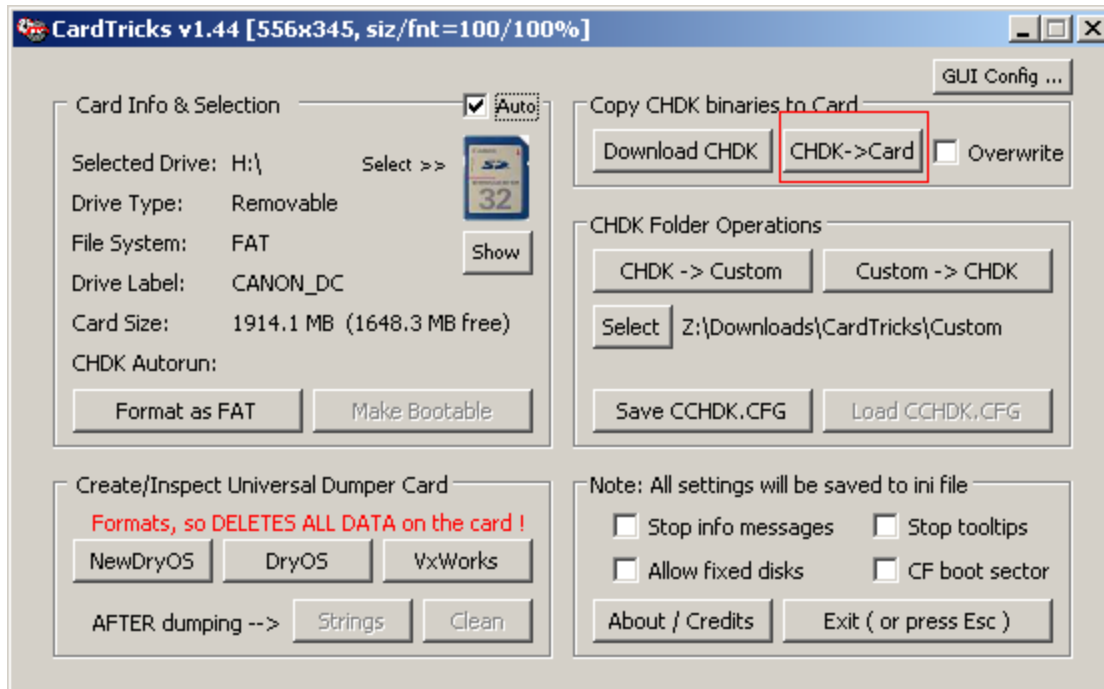


Figure 15: CHDK Setup continued

A dialog will open that will allow you to select the zip file containing CHDK. Select the zip file that you downloaded earlier. Once selected, the zip file will automatically be extracted and installed to your SD card. The SD card can now be ejected from your card reader. Before putting the SD card into your camera, make sure the SD card is in the locked position. CHDK will not start unless the SD card is locked. Locking the SD card will not prevent the camera from recording images on it.

If everything went well, the next time you start the camera, you should see a splash screen with the CHDK logo.



Figure 16: Camera loading screenshot

Further in-depth instructions and alternate methods for installing CHDK (including installation using Mac OS X) are available from CHDK's Installation Guide, found at http://chdk.wikia.com/wiki/File:CHDK_Installation_Guide.pdf.

PC User Software

The PC software is the central interface means to control the camera when it is up in the air on the balloon.

Installing the Software

An executable file of the program is provided upon obtaining the product and should be placed in a directory of the users choosing. Double clicking on the software will start the program.

How to Use

When the user opens the software by double clicking on the program icon, the program will open the window that contains all the means necessary to control the camera.

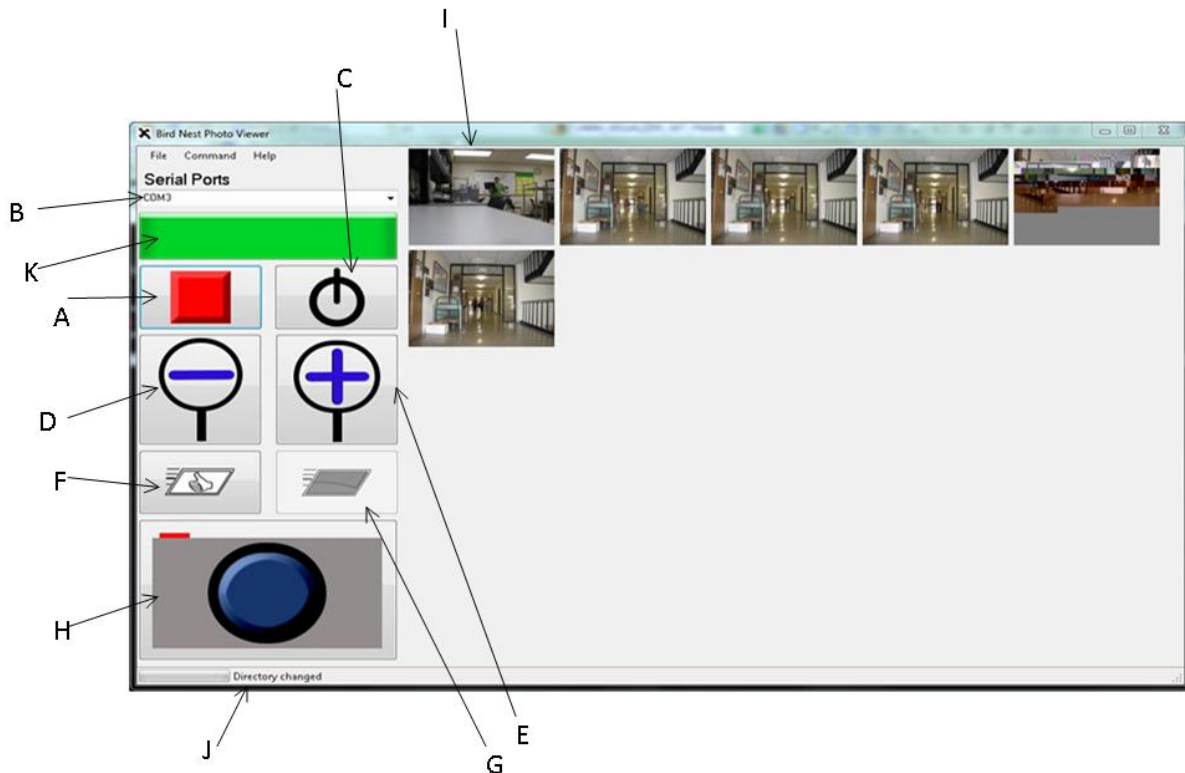
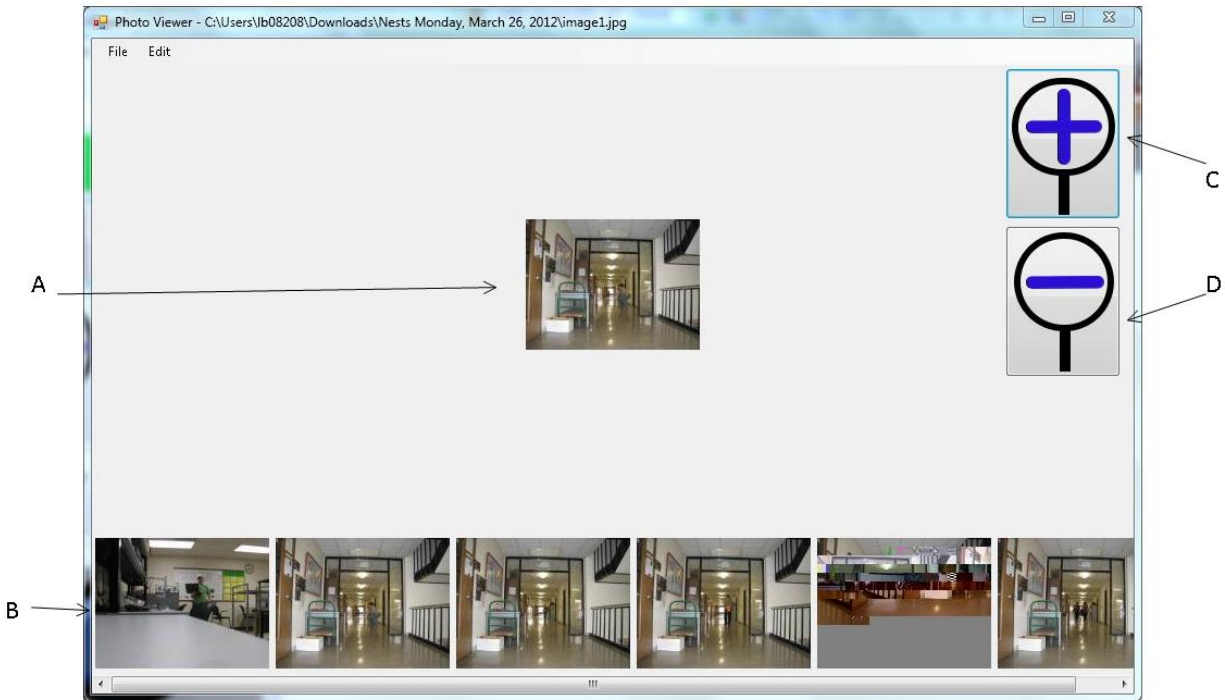


Figure 17: Photo Form

- A. Play/Stop Button – This will initiate communications over the serial port when clicked. It will also stop communications when clicked while running.
- B. Serial Port Drop Down – This contains all the available serial ports on the computer. A port must be chosen before communications can be initiated.
- C. Power Down Button – Will shut down the camera when clicked.
- D. Zoom Out Button – Sends command to camera to zoom out.
- E. Zoom In Button – Sends command to camera to zoom in.
- F. Transfer Thumbnail Button – Sends command to camera to transfer a thumbnail of the most recent photo taken.
- G. Transfer Photo Button – Sends command to camera to transfer the full image of the most recent photo taken.
- H. Capture Button – Sends a command to the camera to capture a photo.\
- I. Photo Viewing Area – Where all photos in the save file will be displayed after transferring to be viewed during operations.
- J. Status Bar – This will contain important messages about command execution.
- K. Battery Level – Displays the battery level of the camera

All images in the photo viewing area of the Photo Form can be clicked on so that they can be opened in a larger viewer and have the size increased to determine viewing area of the camera.



- A. Current Image – Displays the image clicked to then be increased or decreased in size to view.
- B. Other Photos Scroller – Contains all other photos in the viewing folder that can be clicked on and then viewed on a larger scale.
- C. Zoom Out Button – Decreases the size of the image when clicked
- D. Zoom In – Button – Increases the size of the image when clicked.

Before communications with the camera can be initiated the user must plug in to the correct serial port, the XBee communication board.



Figure 18: Choose USB Port

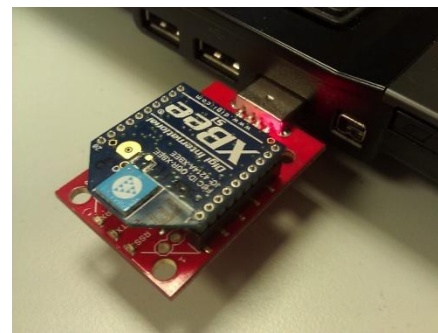
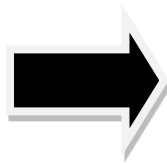


Figure 19: XBee inserted in to USB Port

Follow the steps below to communicate with the XBee and to the camera.

1. In the Serial Port Drop Down select the Serial Port corresponding to the XBee.

NOTE: If you are not aware of which port belongs with the XBee, start the program without the board plugged in and look at the available ports. Then plug in the XBee and restart the program and a new port should be available corresponding to the XBee.

2. Click the Play Button
3. If the Status Bar does not read “Camera Connected” after starting then the program did not make a connection with the camera. A list of messages is in Table 1.
4. If the “Camera Connected” message does appear then the program is communicating and commands can be sent to the camera.

Table 1 - Command Messages

Command Message	Occurrence
Camera Connected	When there exists communication with the camera.
Picture Transfer Start	When the user requests a full photo and the camera acknowledges.
Thumbnail Transfer Start	When the user requests a thumbnail photo and the camera acknowledges
Command Received. Triggering capture!	The camera acknowledges the command and is capturing a photo
Command received. Zooming out	The camera received command and is zooming out
Command received. Zooming in	The camera received command and is zooming in
Command received. Shutting down!	The camera is shutting down
Camera disconnected	The pulse that the camera sends has not been received for an extended period of time and more than likely has lost connection with the PC.
Command received. Sending battery level	The camera is sending the battery level.

When a command completes and the camera is still running, the default message is “Camera Connected”. If at any time a command takes more than a few seconds to complete then there is possibility the acknowledge command did not get received. In this case it is best to close the program and restart it and try again.